

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
31 December 2003 (31.12.2003)

PCT

(10) International Publication Number  
**WO 2004/001824 A1**

(51) International Patent Classification<sup>7</sup>: **H01L 21/28**,  
29/788, 21/8247, 27/115

(21) International Application Number:  
PCT/IB2003/002738

(22) International Filing Date: 12 June 2003 (12.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
02077452.7 20 June 2002 (20.06.2002) EP

(71) Applicant (for all designated States except US): **KONINKLIJKE PHILIPS ELECTRONICS N.V.** [NL/NL];  
Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HENDRIKS, Antonius, M., P., J.** [NL/NL]; Prof . Holstlaan 6, NL-5656 AA Eindhoven (NL). **GUELEN, Josephus, F., A., M.** [NL/NL]; Prof . Holstlaan 6, NL-5656 AA Eindhoven (NL). **DORMANS, Guido, J., M.** [NL/NL]; Prof . Holstlaan 6, NL-5656 AA Eindhoven (NL).

(74) Agent: **DUIJVESTIJN, Adrianus, J.**; Philips Intellectual Property & Standards, Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

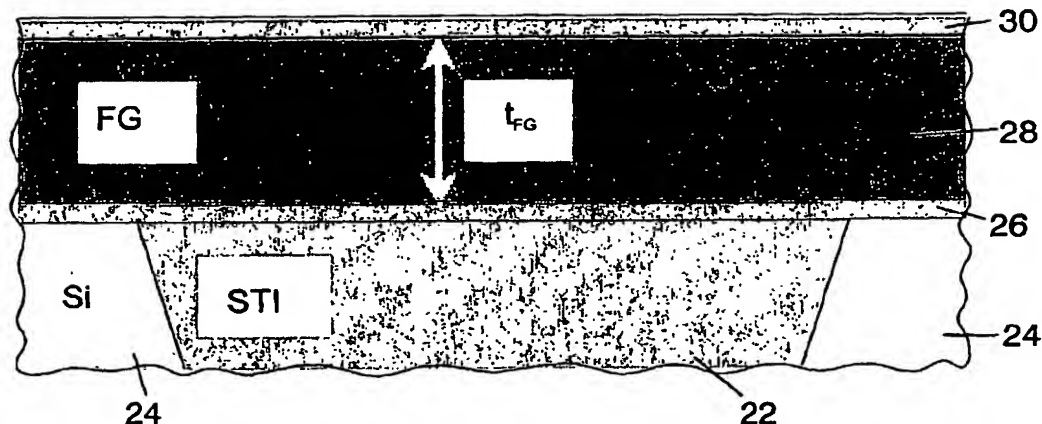
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CONDUCTIVE SPACERS EXTENDED FLOATING GATES



(57) Abstract: A method for manufacturing on a substrate (24) a semiconductor device with improved floating-gate to control-gate coupling ratio is described. The method comprises the steps of first forming an isolation zone (22) in the substrate (24), thereafter forming the floating gate (28) on the substrate (24), thereafter extending the floating gate (28) using polysilicon spacers (40), and thereafter forming the control gate (44) over the floating gate (28) and the polysilicon spacers (40). Such a semiconductor device may be used in flash memory cells or EEPROMs.

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 H01L21/28 H01L29/788 H01L21/8247 H01L27/115

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)  
 EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 198 40 984 A (SIEMENS AG) 18 November 1999 (1999-11-18) the whole document	1-18
A	US 6 235 589 B1 (MEGURO HISATAKA) 22 May 2001 (2001-05-22) the whole document	1-18
A	WO 99 44239 A (HOFMANN FRANZ ; SIEMENS AG (DE); WILLER JOSEF (DE)) 2 September 1999 (1999-09-02) the whole document	1-18
A	US 6 159 801 A (HSIEH CHIA-TA ET AL) 12 December 2000 (2000-12-12) abstract	1-18
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

22 October 2003

Date of mailing of the international search report

29/10/2003

Name and mailing address of the ISA  
 European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

Albrecht, C.

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/IB 03/02738

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>US 5 753 951 A (GEISSLER STEPHEN FRANK)  19 May 1998 (1998-05-19)  abstract</p> <p>-----</p>	1-18

# INTERNATIONAL SEARCH REPORT

ation on patent family members

International Application No

PC1/TB 03/02738

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
DE 19840984	A		18-11-1999	DE	19840984 A1	18-11-1999
US 6235589	B1		22-05-2001	JP	2001196476 A	19-07-2001
				US	2001019152 A1	06-09-2001
WO 9944239	A		02-09-1999	WO	9944239 A1	02-09-1999
US 6159801	A		12-12-2000	US	6380583 B1	30-04-2002
US 5753951	A		19-05-1998	JP	9102593 A	15-04-1997
				KR	234508 B1	15-12-1999
				US	5874337 A	23-02-1999